

## TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

|                        |          |                          |         |            |                   |
|------------------------|----------|--------------------------|---------|------------|-------------------|
| Sampler Location       |          |                          |         | Date       | December 9, 2022  |
| Project Site           |          |                          |         | Start Time | 10:30 AM          |
| Sampler Number         | TSP No.2 | Transfer Standard Type   | Orifice | Stop Time  | 10:45 AM          |
| Motor Serial Number    | TSP No.2 | Calibrator Model         | 25A     | Person     | Mr.Pasagorn Samol |
| Recorder Serial Number | -        | Calibrator Serial Number | 307N    |            |                   |

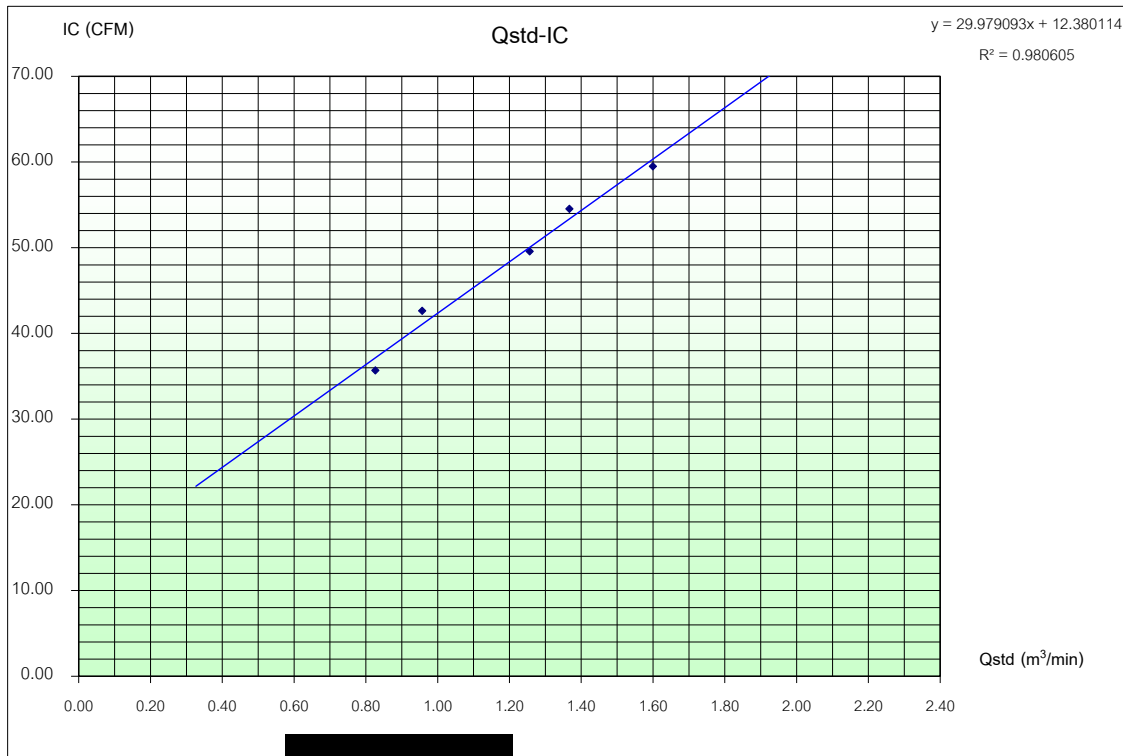
| Plate No. | (Delta H)                                         |          |               | (A)                                           | (X)                      | (I)                        | (Y)                                      | Temperature   | Barometric Pressure | Start Meter | Stop Meter |
|-----------|---------------------------------------------------|----------|---------------|-----------------------------------------------|--------------------------|----------------------------|------------------------------------------|---------------|---------------------|-------------|------------|
|           | Pressure Drop Across Orifice (inH <sub>2</sub> O) |          |               | $[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$ | $Q_{std} = (1/m)[(A-b)]$ | Sample Flow Rate Indicator | $IC = I[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$ | (°K = °C+273) | (mmHg)              |             |            |
|           | Positive                                          | Negative | $\Delta H_2O$ |                                               | (m <sup>3</sup> /min)    | (ft <sup>3</sup> /min)     |                                          |               |                     |             |            |
| 5         | 1.5                                               | 1.4      | 2.9           | 1.67421                                       | 0.82660                  | 36.0                       | 35.70                                    | 303.0         | 760.0               |             |            |
| 7         | 2.0                                               | 1.8      | 3.8           | 1.94336                                       | 0.95703                  | 43.0                       | 42.64                                    | 303.0         | 760.0               |             |            |
| 10        | 3.4                                               | 3.3      | 6.7           | 2.56124                                       | 1.25646                  | 50.0                       | 49.59                                    | 303.0         | 760.0               |             |            |
| 13        | 4.0                                               | 3.9      | 7.9           | 2.78917                                       | 1.36692                  | 55.0                       | 54.54                                    | 303.0         | 760.0               |             |            |
| 18        | 5.5                                               | 5.4      | 10.9          | 3.26965                                       | 1.59976                  | 60.0                       | 59.50                                    | 303.0         | 760.0               |             |            |

Linear Regression Y ON X : Y= mX + b

|        |                               |          |                                                 |       |                |           |                  |                           |             |
|--------|-------------------------------|----------|-------------------------------------------------|-------|----------------|-----------|------------------|---------------------------|-------------|
| 1      | Slope ( m )                   | 2.06353  | Linear Equation                                 |       | Average        | 303.0     | 760.0            |                           |             |
| 2      | Intercept ( b )               | -0.03151 | Set Point Flow Rate ( X ) (m <sup>3</sup> /min) | 1.133 | r <sup>2</sup> | 0.999555  | Pstd(mmHg)       | 760.0                     |             |
| 3      | Correlation Coefficient ( r ) | 0.99993  | Final Set Flow Rate = ( I )                     | 0     | r              | 0.9997775 | T <sub>NTP</sub> | 298.0                     |             |
| Result |                               |          |                                                 |       |                |           |                  | C=(Pa/Pstd)*(Tstd/Ta)^0.5 | 0.991714853 |

COMMENT

Andersen Instruments, Inc.



Calibrated By

## PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

|                        |           |                          |         |            |                   |
|------------------------|-----------|--------------------------|---------|------------|-------------------|
| Sampler Location       |           |                          |         | Date       | December 9, 2022  |
| Project Site           |           |                          |         | Start Time | 10:20 AM          |
| Sampler Number         | PM10 No.2 | Transfer Standard Type   | Orifice | Stop Time  | 10:35 AM          |
| Motor Serial Number    | PM10 No.2 | Calibrator Model         | 25A     | Person     | Mr.Pasagorn Samol |
| Recorder Serial Number | -         | Calibrator Serial Number | 307N    |            |                   |

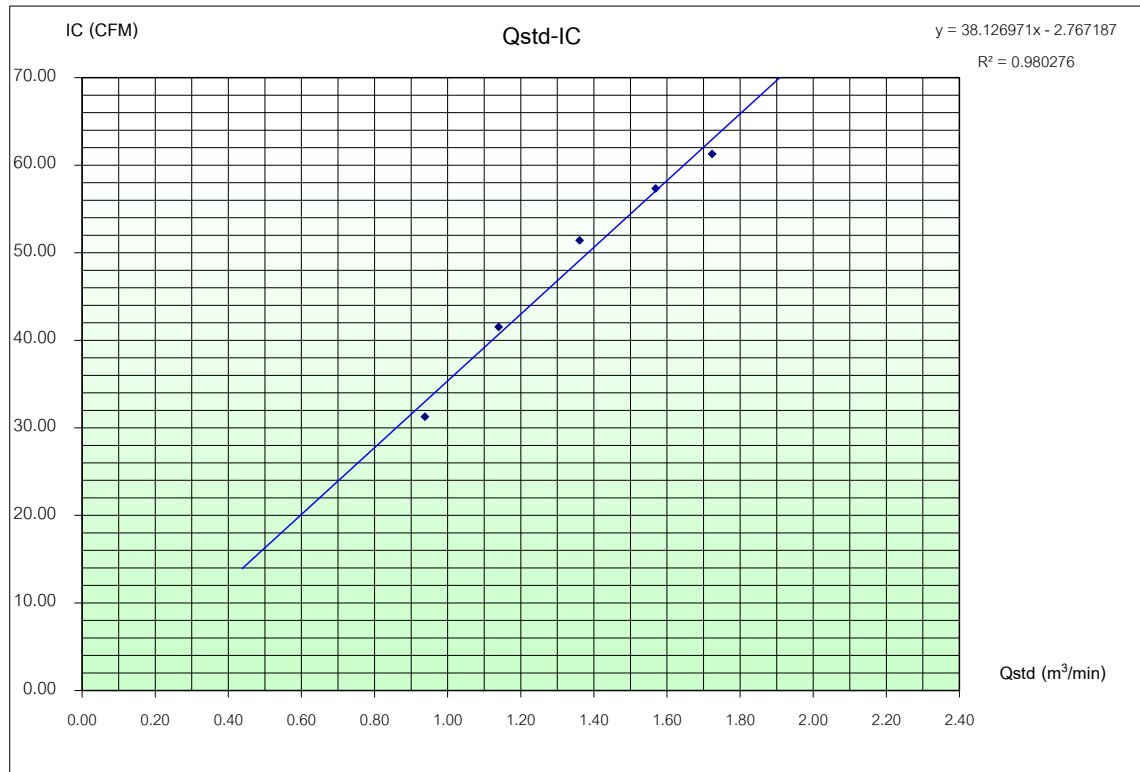
| Plate No. | (Delta H)                                         |          |               | (A)                                           | (X)                      | (I)                         | (Y)                                      | Temperature   | Barometric Pressure | Start Meter | Stop Meter |
|-----------|---------------------------------------------------|----------|---------------|-----------------------------------------------|--------------------------|-----------------------------|------------------------------------------|---------------|---------------------|-------------|------------|
|           | Pressure Drop Across Orifice (inH <sub>2</sub> O) |          |               | $[\Delta H_2O(Pa/P_{std})(T_{std}/Ta)]^{1/2}$ | $Q_{std} = (1/m)[(A-b)]$ | Sample Flow Rate Indication | $IC = I[(Pa/P_{std})(T_{std}/Ta)]^{1/2}$ | (°K = °C+273) | (mmHg)              |             |            |
|           | Positive                                          | Negative | $\Delta H_2O$ |                                               | (m <sup>3</sup> /min)    | (ft <sup>3</sup> /min)      |                                          |               |                     |             |            |
| 5         | 1.9                                               | 1.8      | 3.7           | 1.90390                                       | 0.93791                  | 32.0                        | 31.27                                    | 305.0         | 760.0               |             |            |
| 7         | 2.8                                               | 2.7      | 5.5           | 2.32025                                       | 1.13968                  | 42.0                        | 41.52                                    | 305.0         | 760.0               |             |            |
| 10        | 4.0                                               | 3.9      | 7.9           | 2.77649                                       | 1.36078                  | 52.0                        | 51.40                                    | 305.0         | 760.0               |             |            |
| 13        | 5.3                                               | 5.2      | 10.5          | 3.20602                                       | 1.56893                  | 58.0                        | 57.33                                    | 305.0         | 760.0               |             |            |
| 18        | 6.4                                               | 6.3      | 12.7          | 3.52535                                       | 1.72368                  | 62.0                        | 61.28                                    | 305.0         | 760.0               |             |            |

Linear Regression Y ON X : Y= mX + b

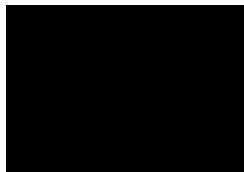
|        |                               |          |                                                 |         |                           |             |                  |       |
|--------|-------------------------------|----------|-------------------------------------------------|---------|---------------------------|-------------|------------------|-------|
|        |                               |          |                                                 | Average | 305.0                     | 760.0       |                  |       |
| 1      | Slope ( m )                   | 2.0635   | Linear Equation                                 |         | $r^2$                     | 0.982631    | Pstd(mmHg)       | 760.0 |
| 2      | Intercept( b )                | -0.03151 | Set Point Flow Rate ( X ) (m <sup>3</sup> /min) | 1.133   | r                         | 0.99127746  | T <sub>NTP</sub> | 298.0 |
| 3      | Correlation Coefficient ( r ) | 0.99993  | Final Set Flow Rate = ( I )                     | 0       | (Pa/Pstd)*(Tstd/Ta)       | 0.97704918  |                  |       |
| Result |                               |          |                                                 |         | C=(Pa/Pstd)*(Tstd/Ta)^0.5 | 0.988457981 |                  |       |

COMMENT

Andersen Instruments, Inc.



Calibrated By



## Analyzer Performance Test

Calibrated Date: 22 April 2022

### Instruments Information

|                                          |                                                      |
|------------------------------------------|------------------------------------------------------|
| Analyzer Type: CO Analyzer<br>Model: 48C | Manufacturer Thermo Environmental<br>S/N: 0604815182 |
|------------------------------------------|------------------------------------------------------|

### Calibration System

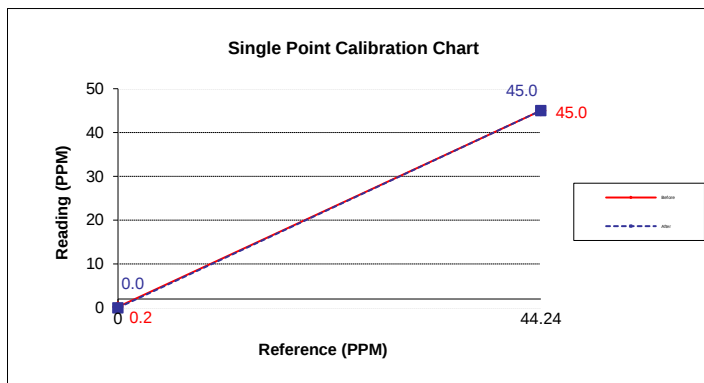
| Calibrator Unit                                                                              | Standard Gas                                                                                                           |
|----------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| Dilutor Model Dasibi Model 5008<br>S/N: 705<br>ZERO AIR Generator API MODEL 701<br>S/N: 1924 | NO Conc 55.47 PPM<br>SO2 Conc 55.11 PPM<br>CO Conc 4,535 PPM<br>Cylinder number EB0129027<br>Expire Date: 29 Oct. 2027 |

Environment: Temperature 25.5 °C

Humidity: 51 %RH

### Calibration Report

| Status | Zero            |               |             | Span            |               |        |
|--------|-----------------|---------------|-------------|-----------------|---------------|--------|
|        | Reference (PPM) | Reading (PPM) | Drift (PPM) | Reference (PPM) | Reading (PPM) | Drift% |
| Before | 0.0             | 0.2           | 0.2         | 44.2            | 45.0          | 1.7    |
| After  | 0.0             | 0.0           | 0.0         | 45.0            | 45.0          | 0.0    |

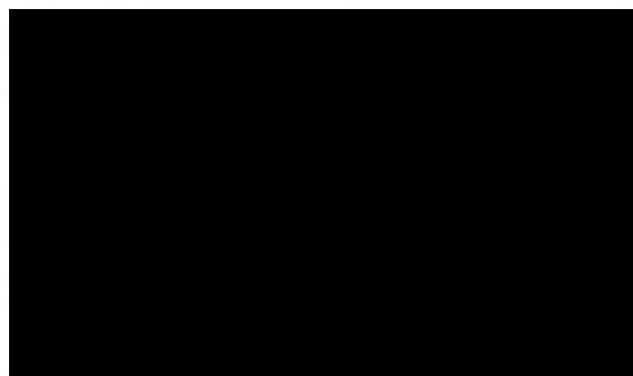


Calibrate By

# CERTIFICATE OF CALIBRATION

NO. 20241008092

|                      |                   |
|----------------------|-------------------|
| Name of Product:     | Sound Level Meter |
| Model:               | ST-21D            |
| Serial Number:       | 821086            |
| Specification:       | Class 2           |
| Conclusion:          | Pass              |
| Date of calibration: | 2025-02-24        |
| Due Date:            | 2026-02-23        |



- I. This report certifies that all calibration equipment used in the test is traceable with the internal ISO9001 procedures and meets all specification given in the Manual(s) or respectively surpass then, and applies only to the unit identified above.
- II. This certificate is produced with advanced equipment & procedures which permit comprehensive quality assurance verification of all data supplied herein.
- III. This certificate of calibration shall not be reproduced except in full, without written permission of the Scarlet Tech Co Ltd Taiwan.

1. Preliminary inspection: OK

2. Type & serial No. of Microphone: AWA14421A-000423

3. Adjustments to indicated sound levels:

Type of Calibrator B&K 4231

Sound Pressure Level 94.0 dB

Equivalent Free-field Sound Level (reference environment conditions) 93.8 dB

4. Measuring up limit: 138 dBA

5. Frequency weightings (Acoustic signal tests for Z weighting, other electric signal tests. )

| Nominal<br>frequency /Hz | Frequency weighting / dB |      |      | Nominal<br>frequency /Hz | Frequency weighting / dB |       |     |
|--------------------------|--------------------------|------|------|--------------------------|--------------------------|-------|-----|
|                          | A                        | C    | Z    |                          | A                        | C     | Z   |
| 20                       | -50.5                    | -6.3 | -0.1 | 1000                     | 0.0                      | 0.0   | 0.0 |
| 31.5                     | -39.6                    | -3.1 | 0.0  | 2000                     | 1.3                      | -0.2  | 0.0 |
| 63                       | -26.3                    | -0.8 | -0.1 | 4000                     | 1.2                      | -0.6  | 0.0 |
| 125                      | -16.2                    | -0.3 | -0.1 | 8000                     | -1.2                     | -3.2  | 0.0 |
| 250                      | -8.7                     | -0.1 | 0.0  | 12500                    | -11.0                    | -13.0 | 0.0 |
| 500                      | -3.3                     | 0.0  | 0.0  | /                        | /                        | /     | /   |

## 6. Self-generated noise

Microphone replaced by electrical input signal device

|            |            |            |
|------------|------------|------------|
| 25.4 dB(A) | 27.5 dB(C) | 38.2 dB(Z) |
|------------|------------|------------|

## 7. F&S Weighting

|                                         |      |
|-----------------------------------------|------|
| Rate of the F weighting decrease (dB/s) | 35.3 |
| Rate of the S weighting decrease (dB/s) | 4.5  |
| Deviation of F&S                        | 0.0  |

## 8. Level Linearity (A-weighting at frequency 1 kHz)

Reference sound level 90.0 dB

Max error at 10dB steps upper reference sound level 0.1 dB

Max error at 1dB steps within 5dB of the upper limit linear operating range 0.0 dB

Max error at 10dB steps below reference sound level 0.1 dB

Max error at 1dB steps within 5dB upper the lower limit linear operating range 0.1 dB

## 9. Tone burst response (A Weighting) :

| Single Toneburst duration /ms | Toneburst response /dB |                 |              |                |
|-------------------------------|------------------------|-----------------|--------------|----------------|
|                               | $L_{AFmax}-L_A$        | $L_{ASmax}-L_A$ | $L_{AE}-L_A$ | $L_{AeqT}-L_A$ |
| 500                           | 0.0                    | -4.0            | -2.9         | -7.0           |
| 200                           | -1.0                   | 7.4             | -6.9         | -7.0           |
| 2                             | -18.0                  | -27.0           | -27.0        | -7.0           |
| 0.25                          | -27.2                  | /               | -36.1        | -7.0           |

## 10. Peak C sound level (500Hz) :

| Cycle              | One cycle | nominal value | Positive half | nominal value | Negative half | nominal value |
|--------------------|-----------|---------------|---------------|---------------|---------------|---------------|
| $LC_{peak}-LC(dB)$ | 3.5       | 3.5           | 2.4           | 2.4           | 2.4           | 2.4           |

## 11. Overload indication: Pass

## 6. Self-generated noise

Microphone replaced by electrical input signal device

|            |            |            |
|------------|------------|------------|
| 25.4 dB(A) | 27.5 dB(C) | 38.2 dB(Z) |
|------------|------------|------------|

## 7. F&S Weighting

|                                         |      |
|-----------------------------------------|------|
| Rate of the F weighting decrease (dB/s) | 35.3 |
| Rate of the S weighting decrease (dB/s) | 4.5  |
| Deviation of F&S                        | 0.0  |

## 8. Level Linearity (A-weighting at frequency 1 kHz)

Reference sound level 90.0 dB

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Max error at 1dB steps within 5dB of the upper limit linear operating range 0.0 dB

Max error at 10dB steps below reference sound level 0.1 dB

Max error at 1dB steps within 5dB upper the lower limit linear operating range 0.1 dB

## 9. Tone burst response (A Weighting) :

| Single Toneburst duration /ms | Toneburst response /dB             |                                    |                                 |                                   |
|-------------------------------|------------------------------------|------------------------------------|---------------------------------|-----------------------------------|
|                               | L <sub>Afmax</sub> -L <sub>A</sub> | L <sub>ASmax</sub> -L <sub>A</sub> | L <sub>AE</sub> -L <sub>A</sub> | L <sub>AeqT</sub> -L <sub>A</sub> |
| 500                           | 0.0                                | -4.0                               | -2.9                            | -7.0                              |
| 200                           | -1.0                               | 7.4                                | -6.9                            | -7.0                              |
| 2                             | -18.0                              | -27.0                              | -27.0                           | -7.0                              |
| 0.25                          | -27.2                              | /                                  | -36.1                           | -7.0                              |

## 10. Peak C sound level (500Hz) :

| Cycle                      | One cycle | nominal value | Positive half | nominal value | Negative half | nominal value |
|----------------------------|-----------|---------------|---------------|---------------|---------------|---------------|
| LC <sub>peak</sub> -LC(dB) | 3.5       | 3.5           | 2.4           | 2.4           | 2.4           | 2.4           |

## 11. Overload indication: Pass

## 12. Statistical analysis function

Sweep signal maximum indicated sound level: 123.0 dB

Sweep amplitude: 40 dB

Scan cycle time: 60 S; Measurement period: 180 S.

| Items              | Measured value/dB | Theoretical calculated value/dB | Error/dB |
|--------------------|-------------------|---------------------------------|----------|
| L <sub>Aeq,T</sub> | 113.3             | 113.4                           | -0.1     |
| L <sub>5</sub>     | 121.0             | 121.0                           | 0.0      |
| L <sub>10</sub>    | 119.0             | 119.0                           | 0.0      |
| L <sub>50</sub>    | 103.0             | 103.0                           | 0.0      |
| L <sub>90</sub>    | 87.1              | 87.0                            | 0.1      |
| L <sub>95</sub>    | 85.1              | 85.0                            | 0.1      |

Uncertainty of measurement results: 0.4 dB (k=2)

### Environment conditions:

Air temperature: 25 °C

Relative humidity: 65 %

Static pressure: 100.0 kPa

### References:

IEC 61672-3 Sound Level Meters Part 3: Periodic tests

# Calibration Certificate

Part Number: 721A2601

Description: Micromate with DIN Geophone

Serial Number: UM16257

Calibration Date: NOV 30 2021

Calibration Reference Equipment: 714J7402

*Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications.*

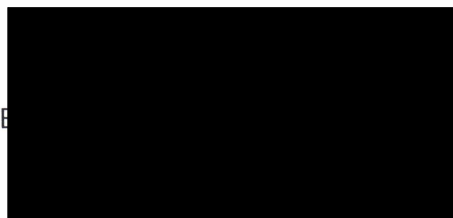
*Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.*

*The environment in which this product was calibrated is maintained within the operating specifications of the instrument.*

*Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard.*

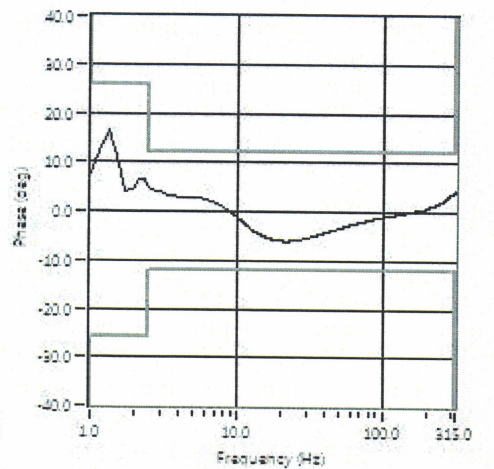
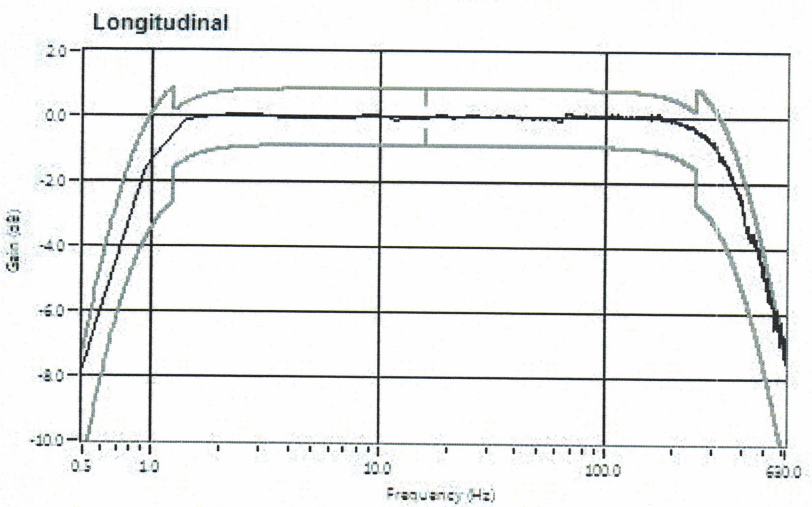
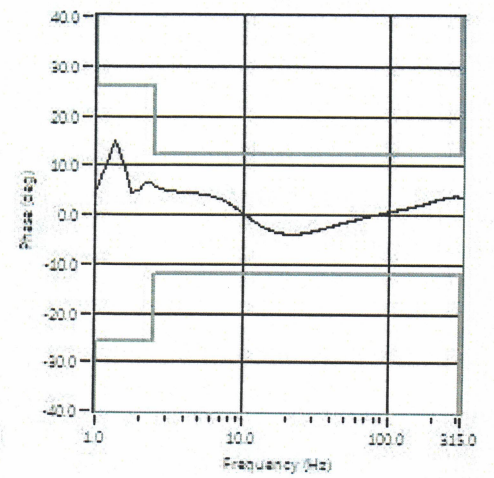
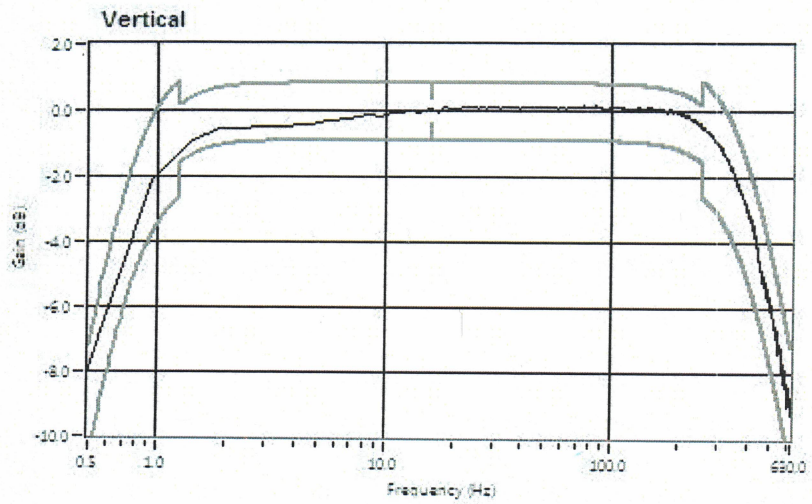
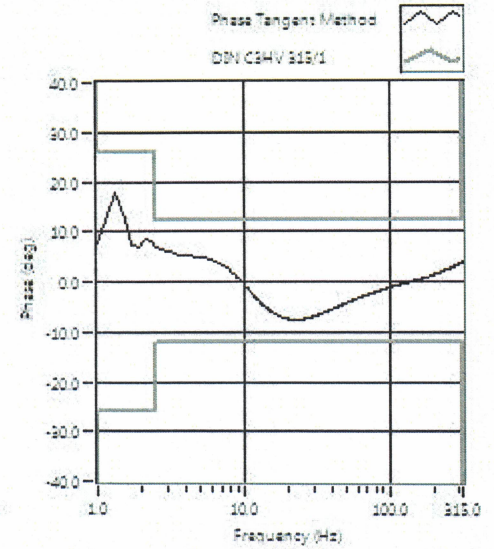
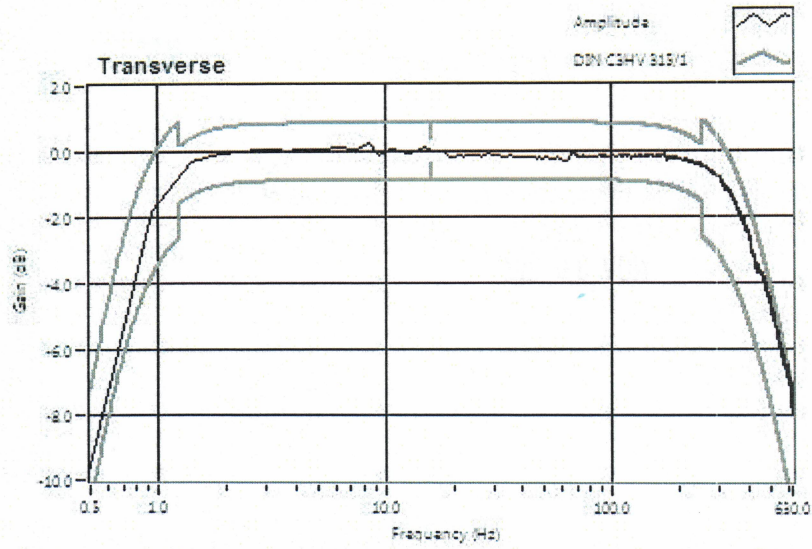
*Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.*

Calibrated By



309 Legget Drive, Ottawa, Ontario, K2K 3A3, (613) 592-4642

# Frequency Response of UM16257





# สทวศวกกร

ตามพระราชบัญญัติวิศวกร พ.ศ. ๒๕๕๒

ออกใบอนุญาตนี้ให้ไว้เพื่อแสดงว่า

บริษัท กรีน เอ็นไว เอ็นจิเนียริ่ง จำกัด

ได้รับอนุญาตประกอบวิชาชีพวิศวกรรมควบคุม

เลขทะเบียน ๑๕๖๕/๖๒

ตั้งแต่วันที่ ๑๖ สิงหาคม ๒๕๖๗ ถึงวันที่ ๑๕ สิงหาคม ๒๕๗๐

